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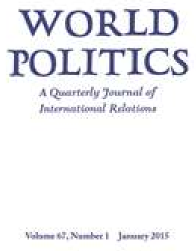

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Review Articles

WAR WITHOUT PAIN, AND OTHER MODELS

By THOMAS C. SCHELLING

Kenneth E. Boulding, *Conflict and Defense: A General Theory*, New York, Harper and Brothers, 1962, 349 pp. $7.00.

I

I DON'T know how many economists, teaching business fluctuations or the corn-hog cycle, have devoted an hour to the household thermostat; I know several. Cybernetics, I am told, drew attention to similarities between vacuum tubes and animal nerve cells, and made predictions about the human nervous system that were verified by surgery. An article on feedback related artillery fire-control and automatic oil-pipeline systems to the ecological complementarity of the lynx and the rabbit. Economists compare the closeness of election campaigns to the market forces that make two brands of cider taste much alike. Analysts of rumor, best sellers, and epidemic diseases have been led independently to the equation for the logistic curve; and the collapse of Batista has been compared to the collapse of a stock market. Individuals with conflicting internal values have been likened to a two-person committee with a complicated voting system; and recently the paradigm of the "prisoners' dilemma" has been used to characterize preemptive attack, cheating on a test ban, and Rousseau's illustration (five men cooperating in a stag hunt when one spies a hare) of the value of enforceable contract.

Everything is unique; and there is no denying that an *adequate* analysis of any phenomenon or decision has to attend to its peculiarities—even if only to verify that they are, for the purpose at hand, of second importance. When Herbert Simon attempted to reduce a large part of George Homans' *The Human Group*[1] to a short set of logical relations among variables (a set of differential equations), he lost a great deal that was in the book. But he also gained something—an accumulated body of mathematical analysis that might not have been recognized as applicable, and a potential for recognizing similarities in any other field of behavior, organic or inorganic, whose mechanism fitted those equa-

[1] New York 1950.

tions.[2] The human leg is not *just* a pendulum; but for understanding the relative gaits of ants, people, and giraffes (or of H. G. Wells' metallic tripods from Mars) it has to be recognized that the leg *is* a pendulum. Natural scientists no longer wonder at discovering the same logarithmic curve in the spiral of the chambered nautilus, the growth of bacteria (or people) in a culture, and the discount on a long-term railroad bond. Many social scientists still do.

Some undoubtedly think it insulting to man "to reduce him to an equation." Some undoubtedly dislike being informed that their literary masterwork can be distilled to a few propositions in topology or information theory, much as the makers of Old Crow may resent their whisky's being described as a lot of water and drugstore alcohol plus traces of a few complicated molecules that are better understood at MIT than in Kentucky. Some may be concerned lest the impatience of single-minded enthusiasts lead, as with Thalidomide, to premature confidence that the details left out of analysis are of secondary importance. And some, partly because the sorting system in most of our colleges sends those with a taste for hard theory into the hard sciences and the rest of us to the soft, just don't like analysis that distills out of a subject what is distinctive about it.

But some do, and among the most insatiable is Kenneth Boulding. Trained an economist, by persuasion a Quaker, hooked early by cybernetics, information theory, and the mathematical biology of his colleague Anatol Rapoport, concerned about war and the evolution of civilization, Boulding has been trying to put together a new science. Six years ago, in *The Image*, he offered a name—*eiconics*. He found it hard to define the field, but placed its roots in the sociology of knowledge. Some idea of its scope is suggested by the three works he then believed had contributed most toward the new science: Chester Barnard, *The Functions of the Executive*; Norbert Wiener, *Cybernetics*; and Claude Shannon and Warren Weaver, *Mathematical Theory of Communication.*

Since then he has fallen for Lewis F. Richardson's astonishingly original and long-neglected work on arms races,[3] has coupled it with economics and game theory (particularly with the work of Martin Shubik on "games of survival" in economics),[4] and has broadened his new science to include virtually all social interaction processes—from war to courtship, from competitive advertising to the lynx and the rabbit—that lend themselves to a common style of systematic analysis.

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[2] H. A. Simon, "A Formal Theory of Interaction in Social Groups," *American Sociological Review*, XVII (April 1952), 202-11.

[3] The most pertinent part of Richardson's work can be found in Lewis F. Richardson, *Arms and Insecurity* (Pittsburgh and Chicago, 1960), edited by Nicolas Rashevsky and Ernesto Trucco. See especially Chapters 2-5. For a review, see John C. Harsanyi, "Mathematical Models for the Genesis of War," *World Politics*, XIV (July 1962), 687-99.

This is evidently too much for a single book; and his *Conflict and Defense* should not be taken to epitomize the new science (if there is to be one) nor the new science made to stand or fall with the book. It is a valuable book, but—and this always sounds patronizing, though it is not meant to be—more important for what it attempts than for what it succeeds in doing. The book is uneven in emphasis, but Boulding is trying both to survey a subject and to develop ideas of his own. The methodology reflects economics more than any other discipline, and the main application is to military relations.

The book divides into two parts, hard and soft. Chapters 8 through 11 and 15 contain no quantitative analysis, no diagrams, no "hard theory." They are what economists used to call "institutional"; they are the stuff of Boulding's earlier book and his earlier definition of his new science. They relate more to the roles of organizations than to systems of interaction. Chapters 1 through 7, devoted to nonspecific theory, and 12 and 13 on military relations, are the "hard" theoretical chapters that build cumulatively; among them, Chapters 1 through 4, 6, 12, and 13 are the core.

The two processes that these chapters are concerned with are epitomized by arms races and war. The book deals with them abstractly; price war and spacial competition in economics, political rivalry, intercollegiate football, or the competition of Methodists and Baptists are equally good interpretations of his basic models. But for concreteness of exposition, and because of Boulding's undisguised interest in problems of war and peace, a military interpretation predominates.

Arms races and war are analytically not wholly distinct. Some kinds of territorial jockeying, for example, have the tempo of arms preparation rather than of destructive engagement. Nevertheless, for modern international warfare there is a useful distinction between competitive preparations and destructive engagements. Descriptively, the distinction is usually between the *accumulation* of arms and their *expenditure*; analytically, it may have more to do with expectations and control. War is usually not just "mutual disarmament," though in some long wars of attrition—perhaps the Peloponnesian war—it is not very useful to separate the war itself from the "arms race." (In Mao's concept of civil war, the "arms build-up" is accomplished through war itself.) In some

[4] Martin Shubik, *Strategy and Market Structure* (New York 1959).

models the difference is between *adaptive* competitive processes and those that, once triggered, run an ineluctable course. The distinction may not prove universally helpful in the abstract; but the particular "basic model" of warfare that Boulding uses is a different species from his arms-race models.

The book invites comparison with Rapoport's.[5] The men are colleagues at Michigan and share a number of enterprises, including the Center for Research in Conflict Resolution. They are both enormously appreciative of Lewis F. Richardson. Rapoport devoted a journal-length essay to Richardson's work, much of which was incorporated in his own book; Boulding proposes the generic name "Richardson processes" for the entire class of interaction phenomena analogous to arms races, and much of his book is devoted to these and related interaction processes. The efforts of Boulding and Rapoport to stake out a new field of inquiry are, though different, nearer to each other than to any other work that I know of. Both men are fascinated by analytical models; both try to transcend any specific application—economics, race, delinquency, war, divorce, arbitration, politics. Both offer a set of concepts, analytical schemes, and terminology with which to build up an organized discipline.

Finally, both have a quality that is likely to confound people who want to organize movements. These are men about the location of whose hearts there can be no question. Both are interested in peace and persuasion, suspicious of military force, sympathetic to disarmament and international institutions, unpersuaded that the Soviet bureaucracy is incorrigibly satanic, willing to explore radical approaches to peace and security, and devoted to peace for reasons that go beyond just the avoidance of war. At the same time, both are intrigued by theoretical ideas—"addicted" is not too strong a term. They have been fascinated by game theory, and not only acknowledge it but build it into their books. Most of those who have recently screamed against "game theory" (outcries really directed at theory, not at game theory) seemed unaware that it could infect the angels too and that some were in fairly high fever. (It is ironic that James R. Newman should have selected some of Richardson's work for his splendid *World of Mathematics*,[6] only to see it inspire the application of game theory and other equally fleshless theories to war and peace.) One can nowhere find as explicit use of game theory or any comparably abstract theory in the published works of

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[5] Anatol Rapoport, *Fights, Games, and Debates* (Ann Arbor, Mich., 1960). For a review, see Robert J. Aumann, "The Game of Politics," *World Politics*, XIV (July 1962), 675-86.

[6] James R. Newman, *The World of Mathematics* (New York 1956), II, 1238-53.

Herman Kahn, Albert Wohlstetter, or even—in his work on military policy—Oskar Morgenstern, as in the books of Boulding and Rapoport.

It is a credit to Boulding, Rapoport, and their colleagues that their *Journal of Conflict Resolution* has not fallen captive to any group, methodological or political. Boulding's book is almost sure to surprise those who know of him, and even some who know him, by the little comfort it will give people who would like him to "prove" the case for some peace movement. His enthusiasm for his theory is understandably great, but his claims for policy are moderate. That, and the fact that his book is hard to read, will keep it from being misused to his embarrassment.

About the durability of his analytical scheme—his concepts, models, and terminology—I am skeptical, just as I was about Rapoport's. A new field may be emerging—I think it is—but we don't know what it is yet. We shall take turns at slicing it up in different ways or marking its boundaries; the eventual definition will reflect the tastes of people attracted to it as much as the nature of the subject. Rapoport's division into "fights, games, and debates" served his purpose, but would not serve Boulding's. Whether Boulding should hold onto his "eiconics," or concentrate on interaction processes, will get a pragmatic answer; and I cannot guess what it will be. The rapid obsolescence of both Boulding's and Rapoport's books would be progress; the contributions of both will be visible in the books that follow—if any do follow, and I hope they will. The subject has a vitality that reflects not just its universality, but its inspiration in peace and war.

II

Few contrasts in the social sciences are more striking than that between the extensive and, on the whole, competent and fruitful models of economic processes, and the almost nonexistent analyses of arms interaction. Boulding points out (p. 25) that the arms race is theoretically similar to the price war; price war, however, has been analyzed professionally and systematically by those who consider economics their business, while the arms race has scarcely been analyzed at all. The reason may be that arms-race theory has not been anybody's business.

There are a few fine exceptions. Lewis F. Richardson's main ideas were substantially published by the outbreak of World War II. The style of his analysis—explicit differential equations denoting the behavior of two or more interacting units—would have been entirely congenial to theoretical economists during the last twenty-five years. Had there been a profession, like economics, ready to gobble up new ideas and new techniques of analysis, the theoretical study of international military relationships might have burgeoned. But Richardson himself remarked, just before his death in 1953, that it was difficult to publish serious analytical work on the subject. "There are many anti-war societies, but they are concerned with propaganda, not research. There is a wide public interest in the subject provided it is expressed in bold rhetoric, but not if it is a quantitative scientific study involving statistics and mathematics. There is no appropriate learned society."[7]

Huntington's monograph[8] should have been exceptionally stimulating; it presented enough historical analysis to show the richness of the subject and enough theoretical discussion to set model-builders going (if there were any around). Burns' article[9] is not only good, but nearly unique; it should be just one of many. And we should all by now be in debt to Stefan Valavanis, whose charmingly original examination of personal interaction suggests that his tragic death in 1958 was a great loss not alone to economics. But few of us, I am afraid, have incurred the debt.[10]

The place to have looked for such work was actually not the pages of *World Politics*, but the several journals devoted to operations research. One might have expected that by now it would be standard form, in discussing the implications of a new weapon, of a warning system, of intelligence breakthroughs, or of alternative deployments of weapons, to include some analysis of how the choice or development would affect the parameters of the arms race. That is, one might insert the new development into a two-sided model—an interaction model—to see what the effect on both sides would be if one or both adopted the new development. This is done for the *tactical* implications of a new weapon; countermeasures and counter-countermeasures are examined in detail. But this kind of analysis is typically confined to interactions that have the character of a "zero-sum" game, interactions in which there is little or no bargaining, little or no common interest in damping an expensive or dangerous competition, little or no opportunity for the interplay of threats and challenges.

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[7] Quoted in the biographical note to Lewis F. Richardson, *Statistics of Deadly Quarrels* (Pittsburgh 1960), xxvi.

[8] Samuel P. Huntington, "Arms Races: Prerequisites and Results," in Carl J. Friedrich and Seymour E. Harris, eds., *Public Policy* (Cambridge, Mass., 1958), 41-86.

[9] Arthur Lee Burns, "A Graphical Approach to Some Problems of the Arms Race," *Journal of Conflict Resolution*, III (December 1959), 326-42. Some interesting unpublished work has been done by Michael D. Intrilligater of the Massachusetts Institute of Technology.

[10] Stefan Valavanis, "The Resolution of Conflict when Utilities Interact," *Journal of Conflict Resolution*, II (June 1958), 156-69.

A similar situation was reflected in the reaction to Herman Kahn's book. The impact of *On Thermonuclear War*[11] was due not to the particular content of the book, but to the fact that it was the first on that subject in that detail after fifteen years of nuclear weapons. Had there been a dozen books on the subject, diverse in opinion and approach, Kahn's book would have been important but not unique, liked and disliked but not passionately. It would not have been a focus for protest. It would not have led people to fear that, if one accepted the legitimacy of his method, one might be stuck with his conclusions. While Kahn's book is not mainly about the arms race, its reception symptomized the paucity of analytical literature.

Boulding's book takes a few more steps, some quite original, toward the rudimentary theoretical equipment necessary for talking about the arms-interaction process. Rapoport's book already made available a simplified interpretation of Richardson's basic model; his presentation did not, however, go beyond the idea that each side's military preparations might be a function of the other's and that the process might be explosive or damped according to a few parameters of the interaction. Boulding has gone farther and built up the notion of a national "reaction function" on the basis of a set of national objectives and costs. Specifically, he introduces the economist's notion of "indifference curves" or, more generally, a system of national preferences; these preferences relate not only to the nation's own military preparations but to the other nation's as well. This is where he draws on the work of Shubik, whose *Strategy and Market Structure* examined the interaction between firms, a firm's profits being a function of its own behavior and the behavior of its rivals.

This is a major step in the elaboration of a model. Among other things, it makes the difference between a model that admits bargaining and one that does not. It permits the negotiation of mutually preferred positions, and decisions consciously oriented toward the reaction of the other side. Compared with the scope and importance of the subject, Boulding's model is still skimpy; compared with what existed, it is a real step forward.

There is a reason why Richardson did not improvise something like the economist's "preference function" on the basis of which the arms-race phenomenon could be theoretically generated. Richardson viewed an arms build-up mainly as a function of hostility or friendliness—as a popular psychological phenomenon. While he was interested in how some of the parameters of the national reaction might be changed, he was dealing with moods rather than budget-making—with something more like autonomous, compulsive, or unconscious behavior than the profit calculus of a firm or the deliberate reaction of a government to a perceived threat.[12]

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[11] Princeton 1960.

The matter is not just one of analytical style. It makes a difference whether the arms race is mainly a matter of popular mood (and military preparations just a symptom) or an interaction between central governments that relate budget plans and weapon decisions to a projection of a perceived threat. Surely the correct position is that it depends on which arms race one is talking about—France and Germany in the 1860's, Britain and Germany in the early 1900's, India and Pakistan in the 1950's, or the Soviet Union and the United States since 1949. Once we have made the distinction, though, we have to recognize that any actual arms interaction is a mixture. Governments make the decisions; popular moods can have a lot to do with the decisions the governments find congenial and with the foreign policies that, at one remove, provide the "objective" basis for armaments programs.

If there is any single mistake to be avoided, it is probably focusing on *the* arms race. Not only do arms races differ historically over time and among the different bilateral and multilateral rivalries that exist at a given time; but even between any pair of countries there is no single interaction phenomenon that can be identified with *the* arms race. In the first place, as mentioned, we have to distinguish between popular moods and government programs.[13] Second, there are at least three different orders of arms race, to be distinguished by their tempo.

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[12] The presentation of his model reflects this concept of "mood." Richardson begins, and Rapoport follows him, with a mathematical description of how mood changes as a function of the mood of the adversary—a pair of differential equations. From this can be derived the curve relating one side's eventual mood to the mood of the other side —what Boulding calls a "partial equilibrium curve." To Richardson the instantaneous reaction is the fundamental process; the derived equilibrium curves are an analytical construct. ("The equations are merely a description of what people would do if they did not stop to think."—*Arms and Insecurity*, 12.) In Boulding the method is reversed. Boulding conceives of each nation's having a preferred position on its own arms build-up scale for any given position the other country may be in. From this he can derive the adjustment process (Richardson's differential equations). Analytically, the one can be translated into the other; but the starting point depends on whether the process is regarded as one of conscious goal-seeking or of instantaneous reaction. This difference in conception is reflected in the organization of Rapoport's book; his theoretical arms race is analyzed in Part I, "The Blindness of the Mass," rather than in Part II, "The Logic of Strategy." He puts the arms race in what he calls "social physics," and relates it to psychological epidemics and other phenomena of mass reaction like the lynx-rabbit cycle. Boulding's explicit references to Shubik make clear that Boulding, perhaps because he is an economist where Rapoport is a mathematical biologist, prefers to deal with self-conscious organizations as decision units. He also, as an economist, sees quantitative limits on arms programs; in Richardson's model there is no boundary to the process except war itself.

One relates to the arms build-up—the dreadnought competition between Germany and Britain before World War I, or the missile build-up of East and West at present. This "race" involves activities measured on a scale of years; lead times in weapons development and procurement guarantee that. Second, there is the phenomenon typified by the "mobilization race" at the outbreak of World War I (and perhaps reflected in some recent crises). The time scale of this interaction is measured in days or weeks; it involves competitive maneuvering for position and readiness, and heightening expectations about war. It, like the slower one, may find a stable equilibrium point at some level of enhanced readiness, or may explode into war. Third, there is the process of interacting *expectations*, which may lead to pre-emptive initiation. This one is probably measured in hours or even minutes; its time scale is that of decision processes and much of the interaction may be conjectural.

In addition, and most nearly analogous to the second one mentioned, is the process nowadays described as "escalation." Limited war itself, if viewed as a heated variant of the cold war, is rather like certain arms-race phenomena. The landing of troops in Lebanon can be viewed both as a step in the "escalation" of a crisis—perhaps even as "escalation" in a war in which no shots were fired—and as a pre-emptive maneuver somewhat like mobilization. (Troop movements in an active Berlin crisis might better reflect the blending of "mobilization" and "escalation.")

Many arms interactions cannot be aptly characterized as a "race." Not all steps that a nation takes to improve its military capability, nor all budgetary outlays, have a purely competitive interpretation. As an extreme illustration, any steps the Soviets can take to minimize the likelihood that they will inadvertently launch general war (e.g., security precautions on nuclear weapons, or warning systems that are less prone to false alarms) are apt to be in our interest. We may not react to the particular steps they take; but, if we do, it is not to make up some lead we have lost. There are some things, of which a secure capability for authentic communication with an enemy in time of war might be an example, in which the interaction may be one of reciprocation. Again, the hardening or dispersal of a missile force within a fixed budget may represent an "improvement" in a country's strategic posture but may not be deplored by the other side; the second country may actually react, in its own planning, in a direction that is reassuring rather than menacing.

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[13] Drawing a diagram with two axes, one labeled "us" and the other "them," leaving it to the reader to interpret the behavior as tangible or intangible, may be momentarily useful for articulating some concepts of interaction. It is a fault of Boulding's presentation that he switches back and forth between a military-program interpretation and a friendliness-hostility interpretation, as though the two were the same. He also seems to imply—and the need for simplification provides some excuse—that the mood of a nation can be analyzed as though it were the mood of an individual. There is undoubtedly some useful analogy between one nation's "hostility" toward another and one person's "hostility" toward another, and there may even be some structural similarities; but they are not the same phenomenon. Also, from a methodological standpoint, one has to distinguish between quantitative phenomena that show continuity over time—going from less to more by traversing values in between—and those that can jump discontinuously from large to small or from love to hate.

If there is a second mistake, then, to avoid in arms-race analysis, it is assuming that all military preparations can be aggregated into a single index involving just "more" and "less," with "more" being invariably and simultaneously more expensive, more hostile, and more dangerous. A missile-hardening race or a bomber-dispersal race may involve greater outlays on both sides, and what looks like "more" military potency; it is not necessarily destabilizing, and probably not usefully characterized as a "race" at all. The interaction may be intense; but what one wants to look for is whether it is mutually beneficial, mutually self-defeating, or of no mutual consequence.

The matter is important because many proposals for arms control, if not all of them, can be viewed as efforts to shift certain parameters in the "arms race" to make the interaction less mutually self-defeating. It is sometimes said of arms limitations that they would simply cause the arms race to bulge in some other direction. This is a useful observation; but, instead of settling the matter, it just identifies what arms control is about. Does the arms race—or, rather, the complex arms interaction—get diverted into less dangerous, more self-stabilizing, less self-aggravating directions, or does it merely bulge in a direction that is perhaps more expensive but otherwise no different?

A splendid example of this kind of analysis is Colonel Kent's monograph.[14] Kent examines alternative quantitative limitations on long-range missiles and their warheads: a limit on numbers, a limit on aggregate yield of the warheads, and some compromises. He explicitly sets up a model in which both sides in an "arms race" have certain missile-strength goals *relative* to the enemy, and examines the strategic forces that both sides are induced to cultivate under the alternative limitations. He examines whether there is a stable equilibrium within the agreed limit, and he compares outcomes under the alternative limits. "Outcomes" reflect the interacting decisions of both participants. He reaches important conclusions. What they are I will not rehearse here; the point is that this kind of analysis, which ought to be common, is rare. Kent's approach should be emulated.

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[14] Glenn A. Kent, "On the Interaction of Opposing Forces Under Possible Arms Agreements," Occasional Paper No. 5 (Center for International Affairs, Harvard University, 1963).

A model of a "missile race" ought to distinguish among several variables: numbers, warhead yields, reliability and accuracy, hardening and dispersal, warning systems, active defenses, target intelligence, capacity for controlled firing, damage assessment, location with respect to civilian targets, procurement and deployment lead time, reliability of enemy intelligence about all of these factors, and reliability of information about the enemy force. The analysis should also distinguish, at another level, between the objective of deterrence and the objective of war initiation or war conduct. One needs a model that can cope not only with the overall size of the force, measured somehow, but with its relevant characteristics. If one examines, with respect to several of these variables, the kind of force that one side would be motivated to deploy as a function of what the other side seems to be deploying, one gets not "the" arms race but a variety of interactions, some benign, some malignant, some neutral. One not only is closer to bridging the gap between theoretical analysis and policy problems, but is on the way to enriching the models themselves.

Take an example. Set up a model in which each side's strategic forces are an explicit function of what the other side is perceived to be acquiring. Insert some plausible quantitative characteristics—vulnerability, accuracy, reliability, target intelligence—and work out the figures for what each wants (and the speed with which it will acquire it), given what it thinks the other has and is currently acquiring. Then add some *uncertainty* about the size of the force on the other side, the lethality of enemy weapons against one's own, or the enemy's lead time in enlarging its force. Explore what this uncertainty does to the forces, or to the build-up trend, on both sides. What kinds of uncertainties are stabilizing, what kinds aggravate problems on both sides? What reactions to uncertainty—e.g., a "conservative" upward bias in estimates—may raise the level of armaments on both sides? What kinds of "multipliers" can one derive, relating the net effect on both sides' programs of some autonomous change in one's program or some systematic error of perception?

The "missile gap" phenomenon of recent years is a reminder that what one reacts to is what he perceives or projects into the future, not the true facts. The Soviets possibly are now worse off for having encouraged a Western exaggeration of the speed of the Soviet missile build-up. They have to react to a Western force that is undoubtedly improved qualitatively, and likely enhanced quantitatively, as a result of what may have been a misperception—one that they stimulated or, at least, acquiesced in. The effects of uncertainty are but one class of arms-race phenomena that may be better understood by the use of theoretical models. In particular the role of "inspection"—which is no less important in the absence of arms agreements than with them—can be better understood.

(To avoid contradicting myself, I must point out that perhaps the Soviets are, in the long run, less menaced in consequence of the American response to the once-forecast missile gap. The qualitative changes in U.S. strategic weaponry and its deployment and control may have made the world safer, whether or not the Soviets realize it—and whether or not they want it that way.)

A "primitive" arms race is one in which each side reacts to the other, without realizing its own influence on the other side. A slightly more sophisticated arms race is one in which each side realizes that the other, too, is reacting, and that one's own adjustments to the environment somewhat determine the future state of that environment. In Rapoport's terminology, the arms race at this point ceases to be a "fight" and becomes a "game." That is, a bargaining element is introduced; behavior becomes self-consciously oriented toward the influence one has, not just a reaction to an autonomous environment. In the more sophisticated model, three things can happen. First, one side can moderate its own behavior with a view to where it wants to end up, given the way the other side reacts. This is the case in which one side is (or thinks it is) dominant or sophisticated, the other blind or unsophisticated. (Incidentally, one of the paradoxes that comes out of an analysis of this situation is that it can easily be to one's advantage to be the blind member, not the controlling member, of the pair.)

Second, both sides can acknowledge the nature of the interaction between them and bargain, perhaps attempting to distort each other's perception of their behavior patterns to make each other more concerned about the costs and risks of not coming to terms. Third, without explicit negotiation of understandings, there may be some bargaining behavior of a tacit or informal sort, each conveying to the other something about its own responses, each conveying the state of affairs that it would consider tolerable.

We have the latter kind of bargaining between East and West at present, though it is far from articulate. Surely the East and West are aware that each side's military posture is substantially a reaction to the other's. Whether the actual military planning process is fully informed by an awareness of the interaction, or is a little more in the nature of "blind" responses to perceived future threats that are considered autonomous, is not an easy question to answer. Governments in the West are not centralized rational decision-making hierarchies; on the other side of the Iron Curtain they probably are not either. But at the level of national policy-making, there is clearly an awareness that what one country does may provoke reactions on the other side. Explicit disarmament negotiations are at least nominally based on this recognition; they cannot yet be said to have affected the process except, for good or ill, to heighten sensitivities to certain aspects of the arms race. But, wholly aside from explicit arms negotiations, there is some evidence that Western governments perceive themselves to be in a continual tacit bargaining process with the Soviets, and evidence that the Soviets see this, too. There were many signs that the Eisenhower administration was inhibited in its defense budgeting not only by the usual fiscal considerations, and not only by a possible worry about an overdeveloped military-industrial complex in this country, but also by a desire not to rock the boat where the arms race was concerned. There was some evidence that the Eisenhower administration declined to get enthusiastic about a large airborne alert force (at a time when the missile gap was causing great concern) partly in order to avoid aggravating the state of relations between us and the Soviets. It is also a fair observation that the reluctance of that administration to engage in any serious civil defense program was at least partly due to a desire not to open up another dimension of the arms race.

When President Kennedy announced increases in the defense budget during the Berlin crisis of 1961, and Khrushchev quickly reciprocated, we were witnessing a process of "communication" as well as one of "preparation." President Kennedy, in effect, was reminding the Soviets that the arms race could be more furious than it was, and would likely become so if the Soviets did not moderate their behavior.

On the whole, this process relates much more to overt political ventures beyond one's borders than to what goes on within borders. In respect of "aggression," we formulate explicit threats and reassurances about what will provoke our military response and what will be safe for the Soviets. We apparently do not articulate "deterrent" threats with respect to the Soviet domestic military build-up. There seems to be nothing quite as self-conscious as what went on, say, between the French and the British in the late nineteenth century, as described by Huntington.[15] In that case, he concludes, the British finally succeeded in communicating to the French a British determination and capacity to enforce a particular ratio of strength, and the French finally acquiesced.

Arms interaction takes place not only between enemies but among allies. Boulding's book touches, at least metaphorically, on this possibility. The level of British armament is a function of the American, perhaps vice versa. (The bargaining is actually more articulate than usually takes place between enemies.) There must be interesting cases in which countries are neither clearly allies nor clearly enemies; Indian officials must sometimes have thought of Pakistani armed forces not solely as potential enemies but possibly as potential allies in certain contingencies. During the postwar period, the French, though mainly allies of the Germans, have surely shown signs that some of their military motivation vis-à-vis the Germans is competitive; whether there is any vague thought that Germany might someday again be an enemy, or just an appreciation that political influence in an alliance is partly a function of one's military contribution, is not clear to us and may not be to them.

To sum up, the arms-interaction process is still almost virgin territory. Specifically, there are some good Ph.D. theses to be found here.

III

In the Declaration of St. Petersburg of 1868 it was asserted that "the only legitimate object which states should endeavor to accomplish during war is to weaken the military forces of the enemy." And in a letter to the Assembly of the League of Nations, dated November 23, 1920, the president of the International Committee of the Red Cross wrote: "The Committee considers it very desirable that war should resume its former character, that is to say, that it should be a struggle between armies and not between entire populations. The civilian population must, as far as possible, remain outside the struggle and its consequences. . . ."[16]

Boulding presents a "basic model" of warfare that in some ways corresponds to the "former character" attributed to war by the Red Cross. (It also corresponds somewhat to Clausewitz' model.) It relates most closely, I think, to continental European warfare between monarchies. Military force is applied against opposing military force; offense is logistically limited; surprise and initiative are consequential only in local engagements; the best defense is what we now call "active defense" (military forces pitted against military forces). The objective is "victory," but the war aims are of no particular concern to the inhabitants, whose principal motive is to save their victuals and their daughters from the troops of either side. And the costs of war are adequately reflected by the drain on a royal treasury.

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[15] Huntington, "Arms Races," in Friedrich and Harris, eds., 64.

[16] International Committee of the Red Cross, *Draft Rules for the Limitation of the Dangers Incurred by the Civilian Population in Time of War* (2nd edn., Geneva 1958), 144, 151.

One can sympathize with the International Committee's nostalgia for the particular "former wars" it had in mind. The ideal would be an affair of honor in which opposing sides could accept any etiquette that might be impartial to the outcome and in which, with respect to the possible spoils of war, both sides wanted to avoid spoiling them by careless destruction. The method of warfare—and Boulding's model is mainly oriented toward the method—was slow and conspicuous travel in a two-dimensional medium, with movement and combat dependent on a secure umbilical cord to one's homeland, and self-sufficient forays limited to the distance a horse could travel carrying his own forage.

Boulding's model is borrowed from the economics of commercial competition. The division of the market between two rival and separated selling establishments reflects their costs of production and transport. The farther from home a firm sells, the higher the transport-cost component in the price the firm must charge. If one firm's costs are so much lower than the other's, even with transport included, that it can undersell the other in its own locale, the second cannot stay in business. In less extreme cases there is a frontier between the firms at which differences in their production costs are compensated by the costs of transport, the frontier being nearer the firm that has the higher production costs. A firm is "unconditionally viable" if it can at least compete near home where its own transport costs are small, against the distant firm whose transport costs are large.

On this analogy, Boulding constructs his "basic model" of international conflict. Each nation has certain resources it can apply to the conduct of war. The potency of these forces diminishes with their distance from home. The farther from home the man, the horse, or the railroad train must go to fight, the more people, horses, trains, forage, and fuel must be consumed in just getting to the front. If one country is so superior in military resources that it can bring superior force to bear even in the other's home base—i.e., after allowance for what is consumed by distance—it can achieve victory. The lesser country is then only "conditionally viable"; it can survive only by sufferance. The rate at which resources are consumed by distance Boulding calls the "loss-of-strength gradient"; it is, in his view, critical to international stability.[17] If the loss-of-strength gradient is steep, either nation has difficulty bringing enough force to bear near the other's home base; if the loss-of-strength gradient is slight, moderate superiority in resources makes victory possible. The loss-of-strength gradient thus determines how great a disparity in military resources can exist between two countries without either's being able to conquer, and tempted to conquer, the other.[18]

Boulding pays a little attention to threats in contrast to war itself. His pessimistic conclusion is that "the very problem of the image of the reputation of the threatener, however, points up a weakness of a threat system like diplomacy and leads to the conclusion that diplomacy must almost inevitably end up in war. . . ." And he fears that threats will not be believed unless they are occasionally carried out (p. 255).

He is concerned, in the elaboration of his model, with the speed of modern warfare. The threat of annihilation, he says, has reached a new intensity, altering the nature of the threat of war so completely that the present situation must be regarded as different in kind from that prevailing under earlier forms of weaponry. "The peculiar danger consists not so much in the destructiveness of the modern weapons but in the rapidity of their application and their world-wide range." But the problem of rapidity for him is not one of surprise, pre-emption, false alarm, or miscalculation; it is rather that everyone sits under the sword of Damocles, threats are intolerable, and desperation is induced (pp. 257-58).

He considers the difference between offensive and defensive armaments. "A shield, a city wall, or a bomb shelter are purely defensive armaments; they lessen the capacity of the enemy to harm but can in no way harm him" (pp. 258-59). The interaction between defensive and offensive arms—the immunity to retaliation or counterattack that defensive weapons may provide, and their release of resources (and possibly of motivation) for offensive action—does not fit into his model. (This is somewhat surprising, Boulding being an economist.)

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[17] Incidentally, if distance is measured directly in units of transport cost, not in miles, the loss-of-strength gradient is replaced by an equivalent parameter of "distance," and we have essentially the model used by Quincy Wright in Appendix XXIX to his *Study of War* (Chicago 1942), II, 1389-91. In Wright's model a country can be conditionally viable in relation to a single enemy while the latter is deterred by the presence of a third country, in a balance of multinational power. A two-country model can probably not explain how the Americans managed to emerge independent from the Revolutionary War.

[18] Clausewitz emphasized the danger of offensive overextension; an offensive that loses momentum in enemy territory leads not to an equilibrium frontier but to a reversal. (Trench warfare as in World War I was not anticipated.) Boulding might allow for this, but not adequately unless he explicitly includes uncertainty. There is no uncertainty in his model; to include it would change the character of the model, especially in relation to the role of threats. Boulding's model cannot handle the preemptive aspect of the Franco-Prussian War or the German gamble on quick victory against France in 1914.

On the whole this analysis is disappointing. The logistically limited land engagement is a significant kind of war, but it is *a* basic model, not *the* basic model. An equally basic model is Malcolm Hoag's, presented in this journal two years ago.[19] It mainly distinguished first-strike and second-strike weapons. It incorporates "pre-emption," "surprise," and "deterrence." Boulding's model cannot—nor can it generate "limited war" or "brinksmanship." Each model is only a piece of the whole system; but if I had to take my choice I'd consider Hoag's pertinent, Boulding's historically interesting. (Hoag's is also historically interesting; the dynamics of preventive or pre-emptive initiation is *not* new, nor is deterrence.)

One can of course interpret Boulding's model in a less geographical sense; obviously, for example, his "distance" needs to be measured in costs, not miles. But he himself considers it of monumental significance that the "range of the projectile" has now virtually eliminated the loss-of-strength gradient; once you can reach half the circumference of the earth, "there are no nooks, corners, or retreats left, and no snugly protected centers of national power. . . . The result is a sudden and dramatic collapse of unconditional viability" (p. 272). "We may run into the paradox that nations can be destroyed without being conquered" (p. 268).

I wonder, as the Red Cross statement made me wonder, whether the present state of affairs is all that new. We have the collapse—Boulding alleges—of active defense against offensive weapons; and we may have the possibility of destruction without conquest. Boulding concludes that "what we face in the modern world is a fundamental breakdown in the concept of defense as a social system, largely, as I have tried to show, as a result of the constant decline in the loss-of-strength gradient affecting almost all institutions as a result both of physical and social invention" (p. 331).

What I wonder is whether it is historically correct that war has typically taken the form of engagement between opposing military forces, and that primary reliance for security has typically depended on the successful defensive interposition of the main body of one's military

[19] Hoag, "On Stability in Deterrent Races," *World Politics*, XIII (July 1961), 505-27.

forces before an advancing enemy. Is "deterrence," in contrast to "defense," peculiar to the era of nuclear weapons and global missiles? (Leave aside the technical and economic question of whether Boulding is right that there is no feasible active defense against missiles with nuclear warheads.) Is reliance on the threat of reprisal, or the threat of making victory painful rather than impossible, completely new? Is the possibility of destruction without conquest unprecedented? Has coercion by violence, and the threat of more violence, not been part of war itself? Did war, as the Red Cross suggests, "formerly" involve only combatants, or does the ideal model of the Red Cross relate to a particular segment of history in a particular sector of the world?[20]

Both the motives and the techniques of war are usually mixtures; historically clean cases are hard to find. The Boulding model, emphasizing logistics, may well explain the location of the European perimeter of the Roman empire. It explains less well the mobile forms of warfare, particularly among maritime powers or those that can swoop onto each other's cities on horseback. Wars of reprisal, wars of annihilation, religious wars, colonial wars, wars for the capture of slaves or hostages, wars of harassment, wars aimed at the home front and civilian morale, wars of siege and blockade, guerrilla warfare, wars with subversion and psychological warfare, and mobile wars of attrition do not easily fit the logistically determined Boulding model. Most of them do not fit the Red Cross conception of war as the exclusive business of combatant troops.

In fact, with some exaggeration one might say that the engagement of troops in war is a preliminary stage. The usual object is eventually to coerce people, either whole populations or key officials, by the threat of violence, and to dispose of some by death, imprisonment, or other immobilization. Just as the purpose of besiegers is not to destroy walls but to get inside where they can have their way with somebody, the purpose of the German advance in 1914 was not to destroy French soldiers but to bring bayonets to bear on civilians (or civilian officials) in the city of Paris. This objective is usually most vivid in the wars we choose to call "civil wars," but the difference is mainly in its visibility, not its presence.[21]

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[20] Western Europe from the Thirty Years' War to World War I, less the Napoleonic period. See J. F. C. Fuller, *The Conduct of War: 1789-1961* (New Brunswick, N.J., 1961), especially Chapters 1, 2, 5, and 6.

[21] Even for combatant troops there may be a *non sequitur* in the St. Petersburg Declaration. After stating that the only legitimate object in war is "to weaken the military forces of the enemy," it goes on to say that "for this purpose it is sufficient to disable the greatest possible number of men," and that this object would be exceeded by arms that aggravate the sufferings of disabled men or render their death inevitable.

When an enemy country is effectively controlled by a responsible government, the second stage of war—the *real* stage—may not occur; surrender negotiation may preclude it. Just as an army may quit when the central front is breached and defeat seems inevitable, a government or a population may quit when the army is destroyed. Occupation troops may not need to wage war against the population; defeat of the population may appear so inevitable that the population—once the cover of military force has been torn away—does not fight. (But sometimes it does, or part of it does, especially if the victor uses his bargaining power badly.) Most of the shooting may be over after a decisive military engagement, but that does not mean that the object in war is to shoot soldiers. The shooting may not even occur; Austria lost a war to Germany in 1938 by surrendering before the first shot was fired. (In Boulding's model, since no uncertainty exists, and no costs of war except the "sunk" costs of the preparations, the country that is not "unconditionally viable" should give up rather than fight; Austria did.)

Both the Red Cross model and the Boulding model lack a theory of the role of violence. War involves pain—pain and fear and cost—not just the sunk cost of munitions acquired earlier, but the costs and risks of war itself. Winning a war is not just cashing in on one's superiority; it is a painful, risky, expensive, and ugly process. War is not just acquisition and loss; it is violent, coercive bargaining—bargaining with demonstrations and threats of further pain, privation, destruction, and risk.[22] And it is often inefficient, hotheaded, undisciplined bargaining—in danger of losing contact with policy.

War involves *intentions* as well as *capabilities.* It involves coercion, intimidation, and deterrence. If a model of warfare ignores the pain, the fear, and the cost of war, it cannot encompass the bargaining proc-

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Similarly, the IVth Hague Convention (1907) forbids "arms, projectiles, or material calculated to cause unnecessary suffering." (Explosive or poisoned rifle bullets, for example, were outlawed.) I believe it is a fair observation, both from the history of warfare and from the history of tactical doctrine, that one main way to weaken the military force of the enemy—often more important than killing and wounding—has been to make the individual enemy soldier too scared to fight effectively. Ardant du Picq's *Battle Studies,* for example, is mainly preoccupied with how to get soldiers to move forward and use their rifles rather than drop behind the nearest hummock; Frederick the Great, as well as the Romans, recommended sharp steel *behind* the advancing troops to help offset the sharp steel in front of them. Whatever the merits of banning them, the weapons of battlefield horror—fire, war cries, elephants, or bombs with sirens—have usually had that same "legitimate" purpose: "to weaken the military forces of the enemy." Terror is not a weapon to which only civilians are vulnerable.

[22] Fuller quotes from a letter by General Sherman after he took Atlanta: "If the people raise a howl against my barbarity and my cruelty, I will answer that war is war. . . . If they want peace, they and their relatives must stop the war." (*Ibid.,* 108-9.)

ess. It cannot recognize *deterrence, intimidation, limited war*, or *surrender*. The economics of viability is a benchmark in the analysis of the bargaining, but only a benchmark. Furthermore, without explicit uncertainty it is hard to generate the phenomenon of brinksmanship—of competitive risk-taking, of the game of "chicken." In fact, with neither uncertainty of outcome nor some advantage in preventive or pre-emptive initiation, it may be hard to explain how an international war can start.

Boulding observes that the 12,000-mile missile spells the obsolescence of defense, i.e., of "active defense"—defense that takes the form of defenders fending off attackers. He concludes that national military establishments have become obsolete as national protectors, and that this is new in history. It is a little surprising that an economist accepts the absolute supremacy of ballistic missiles against any kind of defense, but as a practical matter there is something to be said for his assumption. It seems a peculiarly American notion, however, that it is the 12,000-mile missile that denies the safe nook or cranny. It was denied to the American Indian a hundred years ago, to the Poles at least three hundred years ago, and it was almost denied to the British in 1944 with short-range missiles. The Polaris submarine may prove to be as good at denying safe nooks as the world-ranging missile; but then we may as well recognize that the ocean-going vessel—even the Viking ship—had already done much the same thing when rockets were made with saltpeter. The slave trader's rifle must have been as remorseless a pursuer as the ICBM.[23]

But, supposing that active defense is obsolete, are we to conclude the same about national military forces (other than those whose acknowledged purpose is aggression) or do we just conclude that Boulding's model is obsolete? Don't we need a model oriented toward "deterrence" and "intimidation" rather than just toward ground conquest and active defense? Don't we need models that explicitly examine the motives and decisions to initiate war, to limit or to expand it, and to terminate it, and not just examine the prerequisites for military victory?[24]

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[23] Boulding also avers, in the language of cybernetics, that command and control are necessarily diminished by the modern weapons. "The longer the range of the projectile, the more difficult the receptor-control problem becomes; it becomes more difficult, that is, to know whether the projectile has reached its intended mark and correspondingly more difficult to aim it with a high probability of reaching the mark" (p. 267). Before we become too bemused by sheer mileage, I suggest we ponder some pre-nuclear instances of the fog of war. "During the decisive days of the Marne, the German headquarters at Spa had almost entirely lost touch with their units, could get no word from them, and could send only fragmentary instructions. The order to retreat was given by a Lt. Colonel of the General Staff who had been given full powers by General Headquarters and sent to the front to see what was going on." Guglielmo Ferrero, *Peace and War* (London 1933), 17. The episode is described in some detail in Winston S. Churchill, *The World Crisis, 1911-1918* (abridged and rev. edn., London 1943), 176-81.

It is not necessarily bad news for the peace-loving defensive nation if defensive weapons no longer work. If, for overpowering technological and economic reasons, they no longer work for the defender, they probably no longer work for the conqueror. Defenders have had a pretty hard time of it for several thousand years, particularly those that were not "unconditionally viable" but also those that proved viable only after the tragedy of war. Maybe "deterrence" works better.

Actually, deterrence has always been involved. Japan was surely not unconditionally viable in the early 1940's; but the United States had to be provoked into the war. Italy was not unconditionally viable when it invaded Ethiopia; but intervention was deterred. Vulnerable countries have maintained defensive forces, not in the hope that they can repel an absolutely determined invader, but that they can make conquest unattractive. Forcing the more powerful aggressor to contemplate the sheer cost of winning a bloody and expensive campaign—as, for example, the Swiss have sometimes done—may succeed in deterring where it could not succeed in defending.[25] An era in which the costs of "winning" go up—as measured in civilian pain and damage—even though the technical possibility of victory also increases, could be one in which defensive forces play much the same role as before (perhaps more potently), but in which we are more aware of the deterrent element within that role. There is a difference between *dissuading* and *fending off*, but we tend to exaggerate the historical novelty of dissuasion in the nuclear era.

I see no logical reason to suppose that deterrence is less reliable than active defense. To some it may seem less reliable because more dependent on vagaries of enemy intent, more subtle and psychological; but we are probably most comfortable where we have forgotten defense and rely wholly on deterrence. None of us lives in a secure house.[26]

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[24] Shubik's firms are interested in profit, not maximization of gross sales or the absorption of rivals for its own sake. If Boulding had made payoffs or indifference curves as explicit in his war model as in his arms-race model, he might have been led to the analysis of deterrence, intimidation, limited war, and surrender. Firms, of course, are not single-minded rational calculators, nor are nations at war; what we get is still only an abstract, incomplete model. But the same is true of Boulding's "active-defense" model.

[25] At the Battle of St. Jacob-en-Birs in 1444 the Swiss, outnumbered fifteen to one, attacked the Dauphin's invading army and piled up twice their number in enemy corpses before being themselves extinguished. The price too high, the Dauphin retired with his troops. "From that day the Confederates were able to reckon their reputation for obstinate and invincible courage as one of the chief causes which gave them political importance. . . . It was no light matter to engage with an enemy who would not retire before any superiority in numbers, who was always ready for the fight, who would neither give nor take quarter." (C. W. C. Oman, *The Art of War in the Middle Ages*, Ithaca, N.Y., 1953, 96.) Five hundred years later the Finns demonstrated that the principle still works.

The same might be true in the disarmed world, organized under a benevolent but ruthless national police force, that some people would prefer to rely on. It is unlikely that a world government, or international military force, would rely on active defenses. Deterrence may not be just cheaper and more reliable; it is probably subtler and more civilized, if only because it depends less on brute force and more on the control and management of conflict. The question can be raised, though, whether "mutual deterrence" is a viable state of affairs, or whether deterrence works solely for the organized monopoly against disorganized smaller units.

It is a good question. Intuition is unlikely to give a reliable answer. The kind of work that Hoag, Kent, and others have done on the incentives to initiate war, and how these relate to the parameters of the arms race, is pertinent. So is work on the limitation and termination of war. Boulding's opinion is that deterrence depends on threats, threats induce desperation, and war is nearly inevitable. Whether deterrent threats lead to desperation, hostility, and panic, or to quiescence, confidence, and security, probably depends on how the threats are arrived at and expressed, what demands accompany them, and the costs and risks of initiating violence or reacting to it.

Psychologists often argue that threats induce resistance, tension, and hostility. I'm sure that threats can be designed to do just that, by making them personalized, arrogant, gratuitous, challenging, and explicit. The threats we most readily live with—and that do not continually affront our manhood, excite our arrogance, heighten suspense, or cast us in uncivilized roles—are those that we take for granted. They tend to be implicit and impersonal, somewhat symmetrical, credible without continual protestations of credibility, and to have a tradition of success. The union that may strike, the wife who may leave her husband, the executive who may resign, and the nation that may renounce an alliance, all rely on threats. The psychological consequences so often alluded to —consequences that usually, though not always, are to be deprecated— depend on how the threats are structured and expressed, and what they are used for.

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[26] A strategic reason why conquerors have often been assimilated by the conquered may be that, to enjoy their conquest, they must cease being unencumbered marauders and settle down in wealth and vulnerability. Viking ships of male warriors could surprise the scattered farmers, commandeer their animals for greater mobility on land, and be gone before a superior force could be concentrated against them. But "the settlement of the invaders in the Danelaw . . . greatly simplified the military problem of the English. An enemy with towns to be burned and fields to be ravaged was much more vulnerable than one whose base of operations was the open sea." (*Ibid.*, 25.) The Vikings were nowhere easy to pacify, but they appear to have become most peaceable where they had immobile possessions, like homes and families.

If the participants in a threat system lack the kind of "toughness" that immunizes them to irritation, suspense, and the involvement of personal honor, *substantive* threats are probably best kept for last resort —for "constitutional" issues. Not only should they rarely be brandished, but they should not be continually refined and gerrymandered in daily bargaining. They should be deterrent rather than "compellent."[27] They should support some fundamental *status quo,* superimposed on which is a system of etiquette, law, ritual, diplomacy, arbitration, or self-restraint. The threat for regular use, then, is the threat that persistent violation of the rules, or persistent bad faith, will endanger the "civilization" that has been built. It takes more than just willingness on both sides to do this, though. It takes skill, and perhaps some luck; tradition and confidence depend on experience, not just intentions. (And many of us are not yet persuaded that the intentions are even there.)

My point is not that it is little white threats that make the world go round. It is that nations needn't give up just because military brute force may have to be replaced by threats as a means of protection. In fact, the threats that accompanied the "defensive" weapon systems of 1914 had a few irritant qualities themselves. Perhaps as we become less confident of brute force and more attentive to the role of threats, we can be more subtle, more careful, more civilized about them. If there was no "balance of terror" in pre-nuclear 1914, it was partly because people didn't know enough to be terrified.

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[27] In a recent paper, Boulding looks at the threat as an abstract human relationship and epitomizes it by the proposition, "You do something nice to me or I will do something nasty to you." (Boulding, "Toward a Pure Theory of Threat Systems," to appear in *Papers and Proceedings, American Economic Review,* 1963.) This, in my scheme, is a "compellent" rather than a "deterrent" threat. It does sound a little antagonistic.